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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/603,795	06/26/2003	Vasilis Papavassiliou	D-20792	3468

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EXAMINER	
LEUNG, JENNIFER A	
ART UNIT	**PAPER NUMBER**
1764	

SHORTENED STATUTORY PERIOD OF RESPONSE	MAIL DATE	DELIVERY MODE
3 MONTHS	02/16/2007	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

If NO period for reply is specified above, the maximum statutory period will apply and will expire 6 MONTHS from the mailing date of this communication.

Office Action Summary	Application No.	Applicant(s)	
	10/603,795	PAPAVASSILIOU ET AL.	
	Examiner	Art Unit	
	Jennifer A. Leung	1764	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *29 November 2006 and 26 October 2006*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-15* is/are pending in the application.

4a) Of the above claim(s) *11-15* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-5 and 7-10* is/are rejected.

7)☒ Claim(s) *6* is/are objected to.

8)☒ Claim(s) *1-15* are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *26 October 2006* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Jennifer Leung 2/14/2007

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Response to Amendment

1. Applicant's amendment submitted on October 26, 2006 and Applicant's response to a Notice of Non-Compliant Amendment submitted on November 29, 2006 have been received and carefully considered. The amendment to the Drawing is acceptable. Claims 11-15 are withdrawn from consideration. Claims 1-10 are under consideration.

Claim Rejections - 35 USC § 103

The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

2. Claim 1 is rejected under 35 U.S.C. 103(a) as being unpatentable over Burch et al. (US 2001/0154222) in view of Wentinck (WO 01/18451) and Miyoshi (JP 62-125856).

Burch et al. (FIG. 2) discloses an autothermal reactor **70** comprising:

a mixing chamber **80** having an orifice (i.e., of distribution device **76**) to expand an oxygen-containing stream (i.e., supplied at pipe **74**) into said mixing chamber, and an inlet (i.e., at the end of fuel injector **72**) located adjacent to said orifice for introducing a hydrocarbon-containing stream into the mixing chamber **80**;

an initial partial oxidation reaction zone (i.e., an electrically heated catalyst **84**) having a supported partial oxidation catalyst (e.g., a platinum catalyst; section [0028]) in communication with the mixing chamber **80** and followed by at least two endothermic reforming reaction zones (i.e., catalyst regions **90** and **92**; sections [0033], [0034]); and

the at least two endothermic reforming reaction zones **90,92** containing a precious metal catalyst supported on supports (e.g., a suitable catalyst such as a platinum-rhodium catalyst

mounted on a suitable substrate or monolith for region **90**; also, a catalyst similar to the light-off catalyst or a steam reforming catalyst for region **92**; see sections [0033], [0034]).

Burch et al., however, is silent as to the inlet for the hydrocarbon-containing stream being oriented to introduce the hydrocarbon-containing stream into the mixing chamber **80** tangentially to the oxygen-containing stream.

Wentinck (FIGs. 1, 2) teaches a mixing chamber **2** having an orifice (i.e., outlet opening **8**) to expand an oxygen containing stream **6** into said mixing chamber, and an inlet (i.e., outlet opening **5**) located adjacent to said orifice **8** for introducing a hydrocarbon containing stream **3** into the mixing chamber, wherein the inlet **5** for the hydrocarbon containing stream **3** is oriented to introduce the hydrocarbon containing stream **3** into the mixing chamber **2** tangentially to the oxygen containing stream **6** (see page 6, line 5 to page 7, line 5).

It would have been obvious for one of ordinary skill in the art at the time the invention was made to configure the inlet for the hydrocarbon-containing stream to be oriented to introduce the hydrocarbon-containing stream into the mixing chamber **80** tangentially to the oxygen-containing stream in the apparatus of Burch et al., on the basis of suitability for the intended use, because such configuration provides for rapid mixing of the hydrocarbon-containing and oxygen-containing streams, and the occurrence of a wall jet of the hydrocarbon-containing stream avoids the presence of quasi-stagnant oxygen-rich zones along the side wall of the mixing chamber, as taught by Wentinck (see page 6, lines 20-29; see also page 2, lines 7-16).

Burch et al. is further silent as to the precious metal catalyst in the at least two reforming reaction zones **90,92** being supported on supports formed of different materials, wherein the materials provide a greater surface area for a successive **92** of the at least two endothermic

reforming reaction zones than an initial **90** of the at least two endothermic reforming reaction zones, such that the initial **90** and successive **92** of the at least two endothermic reforming reaction zones is configured to operate at ever decreasing operational temperatures such that a material making up a support of the successive **92** of the at least two endothermic reforming reaction zones remains stable. Applicants have disclosed that the different materials of alpha-alumina and gamma-alumina, used as supports for the initial and successive endothermic reforming reaction zones, respectively, meet the claimed criteria.

Miyoshi (see FIG. 1; Abstract) teaches a monolithic catalyst comprising precious metals supported on supports formed of different materials, wherein the support material of the initial zone (i.e., the upstream coating layer) comprises alpha-alumina and the support material of the successive zone (i.e., the downstream coating layer) comprises gamma-alumina.

It would have been obvious for one of ordinary skill in the art at the time the invention was made to configure the supports, for supporting the precious metal catalysts in the at least two endothermic reforming reaction zones **90**, **92** in the apparatus of Burch et al., to comprise different support materials meeting the instantly claimed physical criteria (such as alpha alumina and gamma alumina, respectively), because the claimed configuration of support materials helps prevent the reduction in catalytic activity that occurs under high temperatures, as taught by Miyoshi.

3. Claim 2 is rejected under 35 U.S.C. 103(a) as being unpatentable over Burch et al. (US 2001/0154222) in view of Wentinck (WO 01/18451) and Miyoshi (JP 62-125856), as applied to claim 1 above, and further in view of Sederquist (US 4,381,187).

Burch et al. is silent as to the mixing chamber **80** defining an inner surface outwardly

diverging from said orifice to form a frustum of a cone, wherein the angle of divergence is calculated to inhibit recirculation within the mixing chamber.

Sederquist (FIG. 1; column 6, lines 46-68; column 7, lines 44-61) teaches a mixing chamber **18** defining an inner surface (i.e., defined by conical upstream diffuser **14**) outwardly diverging from the orifice **22** to form a frustum of a cone.

It would have been obvious for one of ordinary skill in the art at the time the invention was made to substitute the mixing chamber shape as taught by Sederquist for the mixing chamber **80** shape in the modified apparatus of Burch et al., on the basis of suitability for the intended use and absent showing any unexpected results thereof, because the mixing chamber shape taught by Sederquist allows for sufficient vaporization and mixing of the hydrocarbon and oxygen containing streams. The angle of divergence for the inner surface of the mixing chamber does not confer further patentability to the claim because the specific angle of divergence would have been considered a result effective variable by one having ordinary skill in the art. Accordingly, one of ordinary skill in the art would have routinely optimized the angle of the inner wall of the mixing chamber to obtain the desired vaporization and mixing characteristics for the hydrocarbon and oxygen containing streams, *In re Boesch*, 617 F.2d. 272, 205 USPQ 215 (CCPA 1980), and where the general conditions of a claim are disclosed in the prior art, discovering the optimum or workable ranges involves only routine skill in the art, *In re Aller*, 105 USPQ 233.

4. Claims 3-5 and 7-10 are rejected under 35 U.S.C. 103(a) as being unpatentable over Burch et al. (US 2001/0154222) in view of Wentinck (WO 01/18451) and Miyoshi (JP 62-125856), as applied to claim 1 above, and further in view of Goebel et al. (US 6,921,516).

Regarding claims 3 and 5, the same comments with respect to Burch et al., Wentinck and Miyoshi apply. In addition, Burch et al. discloses that the partial oxidation zone **84** is formed by a monolithic support (see section [0028]). Burch et al. further discloses,

> "The-light off catalyst region **90** includes a suitable catalyst, such as a platinum-rhodium catalyst, mounted on a suitable substrate or monolith depending on the application requirements. Foams or other structures can also be used that induce gas-to-catalyst surface interaction and provide reaction stability." (section [0033]).
>
> "In one embodiment, the main catalyst region **92** includes a 600 cells per square inch (CPSI) parallel channel monolith made of cordierite having a similar catalyst as the light-off catalyst. The main catalyst could be made of other materials and geometric configurations, as would be well understood to those skilled in the art." (section [0034]).

Although Burch et al. is silent as to reaction zones **90** and **92** each being formed, specifically, as a bed of pellets, it would have been obvious for one of ordinary skill in the art at the time the invention was made to configured each of the reaction zones **90** and **92** in the modified apparatus of Burch et al. as a bed of pellets, on the basis of suitability for the intended use and absent showing any unexpected results thereof, because the provision of catalysts in the form of a fixed bed of pellets for inducing gas-to-catalyst surface interaction and providing reaction stability is well known in the art of catalysis. Furthermore, the substitution of known equivalent structures (e.g., the substitution particulate catalyst for monolithic catalyst, and vice versa) merely involves routine skill in the art. *In re Fout* 213 USPQ 532 (CCPA 1982); *In re Susi* 169 USPQ 423 (CCPA 1971); *In re Siebentritt* 152 USPQ 618 (CCPA 1967); *In re Ruff* 118 USPQ 343 (CCPA 1958). Goebel et al. further evidences equivalency (see column 5, lines 8-17).

Regarding claim 4, a ceramic heat shield of honeycomb configuration (i.e., a substrate **86**,

made of various material such as ceramic, and in the form of a honeycomb structure; see section [0032]) is located between the partial oxidation reaction zone **84** and the mixing chamber **80**.

Regarding claim 7, the mixing chamber **80**, the partial oxidation reaction zone **84**, and the endothermic reaction zones **90** and **92** are in an inline relationship (see FIG. 2).

Regarding claim 8, as defined by Applicants, the materials of alpha-alumina and gamma-alumina meet the instantly claimed physical criteria. Thus, the modified apparatus of Burch et al. structurally meets the claim.

Regarding claim 9, the precious metal catalyst may comprise Pt or Rh (see sections [0028], [0033] and [0034]).

Regarding claim 10, the monolithic support **84** is doped with a partial oxidation catalyst (i.e., a substrate or monolith catalyzed with platinum; see section [0028]). Although Burch et al. is silent as to the support **84** material being ceramic, it would have been obvious for one of ordinary skill in the art at the time the invention was made to select ceramic as the material for forming support **84** in the modified apparatus of Burch et al., on the basis of suitability for the intended use and absent showing any unexpected results thereof, because the use of ceramic material for forming monolithic catalyst supports is well known in the art of catalysis. For example, Wentinck evidences the conventionality of using ceramic material for forming the monolithic support for a partial oxidation catalyst **16** (see page 7, lines 10-13).

Allowable Subject Matter

5. Claim 6 is objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

The prior art does not disclose or adequately teach the apparatus as claimed in claims 1-3, further comprising a secondary mixing chamber situated between the partial oxidation reaction zone and the at least two endothermic reforming zones, wherein the secondary mixing zone comprises a secondary inlet to receive a recycle stream containing synthesis gas components obtained by separation of hydrogen and carbon monoxide from said synthesis gas.

Response to Arguments

6. Applicant's arguments with respect to the rejection(s) of claims 1-5 and 7-10 under 35 U.S.C. 103(a) have been fully considered and are persuasive (i.e., Applicants argued that there was no teaching of tangential mixing between the hydrocarbon-containing and oxygen-containing streams in Burch et al.). Therefore, the rejection has been withdrawn. However, upon further consideration, a new ground(s) of rejection is made in view of the newly found prior art to Wentick, who teaches the claimed feature of tangential mixing. In addition, newly found prior art to Miyohsi and Goebel et al. has been applied.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Jennifer A. Leung whose telephone number is (571) 272-1449. The examiner can normally be reached on 9:30 am - 5:30 pm Monday through Friday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Glenn A. Caldarola can be reached on (571) 272-1444. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications

may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

Jennifer A. Leung
February 14, 2007